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Description

SHOE CONSTRUCTION UTILIZING A BOOTIE WITH AN IMPERVIOUS SOLE AND A METHOD OF PRODUCTION

Cross Reference to Related Applications

[0001] This patent application is a continuation-in-part of U.S. Patent Application Serial No. 10/063,458 filed April 24, 2002, currently pending.

Background of Invention

[0002] Footwear that is currently available that is marketed as being "waterproof and breathable" has been found by the user to be excessively hot and uncomfortable. The reason for this discomfort is that although this footwear is water-proof and moisture vapor transmissive, this footwear is not air permeable. Therefore, the human foot is com-pletely sealed and does not have any access to fresh air.

[0003] The present invention is directed to overcoming at least this problem as set forth above.

SUMMARY OF INVENTION

[0004] In one aspect of this invention, a shoe construction is disclosed. This shoe construction includes a sole and an upper, wherein the sole and the upper together define a volume for receiving and protecting a wearer's foot against external elements. There is a liquid impermeable bootie that includes an inner, upper liner that is attached to a sole liner. The inner, upper liner is moisture vapor transmissive, oleophobic and liquid impermeable and is located inside the upper. In the preferred embodiment, the inner, upper liner is air permeable. The sole liner is air impermeable, moisture vapor impermeable and liquid impermeable and is located above the sole.

[0005] In another aspect of this invention, a process for producing a shoe construction is disclosed. This process includes providing a sole and providing an upper that together define a volume for receiving and protecting a wearer's foot against external elements. This is followed by securing a liquid impermeable bootie, having an inner, upper liner that is attached to a sole liner, within the shoe so that the inner, upper liner that is located underneath the upper and the sole liner is located inside the upper. The inner, upper liner is moisture vapor transmissive, oleophobic

and liquid impermeable. In the preferred embodiment, the inner, upper liner is air permeable. The sole liner is air impermeable, moisture vapor impermeable and liquid impermeable.

[0006] These are merely two illustrative aspects of the present invention and should not be deemed an all-inclusive listing of the innumerable aspects associated with the present invention. These and other aspects will become apparent to those skilled in the art in light of the following disclosure and accompanying drawings.

Brief Description of Drawings

[0007] For a better understanding of the present invention, reference may be made to the accompanying drawings in which: FIG. 1 is a perspective view of an illustrative, but nonlimiting, shoe construction embodying the present invention.

[0008] FIG. 2 is an enlarged, fragmentary, sectional view taken along Line 2-2 of FIG. 1 that illustrates the inner, upper liner of the shoe embodying the present invention.

[0009] FIG. 3 is an enlarged, fragmentary, sectional view taken along Line 3-3 of FIG. 1 that illustrates the inner, upper liner of the shoe embodying the present invention.

[0010] FIG. 4 is an enlarged, fragmentary, sectional view taken

along Line 4-4 of FIG. 1 that illustrates the inner, upper liner of the shoe embodying the present invention.

[0011] FIG. 5 is a perspective view of a bootie of the present invention, including a inner, upper liner and a sole liner, shown apart from the illustrative shoe construction.

[0012] FIG. 6 is an enlarged sectional view taken along Line 6-6 of FIG. 5 that illustrates the bottom of the sole liner for the bootie embodying the present invention.

Detailed Description

[0013] Referring now to FIGS. 1, 2, 3 and 4, an illustrative shoe is generally indicated by numeral 10, although virtually any type of shoe can be utilized with the present invention. This shoe 10 includes both a sole 12 and a portion for receiving a human foot that is otherwise known as an upper 14. The shoe 10 typically includes a front lacing 26 that is engaged in eyelets 24. Moreover, the shoe 10 typically includes a tongue portion 32 that is preferably secured at the sides to the remainder of the shoe 10 through fold portions 34. This allows for the contraction and expansion of the upper 14 of the shoe 10 so that the user of the shoe 10 can insert and remove his or her foot. Moreover, this also provides room for adjustment so that when the front lacing 26 is secured, the shoe 10 is firmly attached

to the foot of the user. For this particular type of shoe 10, in this nonlimiting embodiment, there is a top connecting strip or cap 28 that is doubled over the top of the upper 14 and preferably, but not necessarily, held in position by stitching 22. The upper 14 of the shoe 10 can be manufactured with a wide variety of materials and is preferably leather. The illustrative, but nonlimiting, embodiment can include flexible, lightweight material 20 located in cutout portions on the upper 14 of the shoe 10. The upper 14 can be secured to the sole 12 of the shoe 14 by a wide variety of attachment processes, which preferably includes adhesives. In this illustrative, but nonlimiting example, the upper 14 is secured to the sole 12 of the shoe 14 by the method of stitching 38, as best illustrated in FIGS. 2 and 3.

[0014] Optionally and preferably, there is at least one layer of textile material forming an upper layer 42 located underneath the upper 14 of the shoe 10 next to the foot of the wearer of the shoe 10. A wide variety of textile fabrics can be utilized including woven, nonwoven and knit fabrics. An illustrative, but nonlimiting, type of fabric that can be utilized for this upper layer 42 is a warp knit fabric. Examples of warp knit fabrics include the ECLIPSE 100H™ (an

abrasive resistant polyester and nylon combination fabric), ECLIPSE 200S™(an abrasive resistant polyester and nylon combination fabric) and ECLIPSE 400H™ (a lightweight, nylon fabric), all manufactured by Tempo Shain Corporation, having a place of business at 27 Congress Street, Salem, Massachusetts 01970. Another illustrative, but nonlimiting, fabric that can be utilized for this upper layer 42 includes a three (3) bar knit fabric. Still another illustrative, but nonlimiting, fabric that can be utilized for this upper layer 42 includes a nonwoven fabric that is a combination of nylon 6 and nylon 66, which is point thermally embossed, abrasion resistant and marketed as CAMBRELLE® fabric, which is manufactured by the Faytex Corp., having a place of business at 185 Libbey Parkway, Weymouth, Massachusetts 02189.

[0015] Referring now to FIGS. 5 and 6, there is bootie, which defined as being a sock-like internal liner for the shoe 10 and is generally indicated by numeral 100. The bootie 100 is formed by an inner, upper liner 36 that is attached to a sole liner 40.

[0016] Referring to FIGS. 2, 3, 4 and 5, the inner, upper liner 36 that is located inside the upper 14 of the shoe 10 and above the upper layer 42 (if the optional upper layer 42 is

present). Optionally, there may be one or more additional layers of textile-type material that are located between the upper 14 and the inner, upper liner 36 or the inner, upper liner 36 and the upper layer 42. However, the inner, upper liner 36 may be directly attached to the upper 14 of the shoe 10. Some of these additional layers of textile material may include virtually any type of textile material including scrims, tricot knits, nonwovens, among numerous other possibilities. Illustrative, but nonlimiting, methods of attaching the inner, upper liner 36 to the upper 14 of the shoe 10 preferably includes lamination, however, adhesives and stitching may be utilized. However, the bootie 100 may even be removable from the shoe 10.

[0017] The sole 12 can preferably include an outsole 16, a midsole 18, an insole 30, and the sole liner 40 located between the insole 30 and the midsole 18. However, the sole 12 may combine one or more of these elements into a single unitary structure that combines one or more of these components and any permutation thereof. The midsole 18 is optional and can be attached to either the outsole 16 or the sole liner 40.

[0018] Referring now to FIGS. 5 and 6, the inner, upper liner 36, of the bootie 100, includes a top opening 54 that con-

forms to the upper 14 for the shoe 10 and includes a tongue portion 56. The tongue portion 56 of the inner, upper liner 36 conforms to the tongue portion 32 for the upper 14 of the shoe 10 so that the upper 14 can expand and contract when a human foot is either inserted into the shoe 10 or removed from the shoe 10. A preferred method of manufacturing the inner, upper liner 36 is to connect a first portion 58, which is preferably one-half of the inner, upper liner 36, to a second portion 59, which is preferably the other one-half of the inner, upper liner 36, with a back seam 62 of stitching. The back seam 62 of stitching is sealed with a back seam tape 60. The first portion 58 of the inner, upper liner 36 is also connected to the second portion 59 of the inner, upper liner 36 through a front seam 66 that is sealed by a front seam tape 64. In addition, the tongue portion 56 of the inner, upper liner 36 is secured to the first portion 58 of the inner, upper liner 36 by a first tongue seam 70 at a fold portion 57. The first tongue seam 70 is sealed by a first tongue tape 68. The tongue portion 56 of the inner, upper liner 36 is secured to the second portion 59 of the inner, upper liner 36 by a second tongue seam 72 at a fold portion 77. The second tongue seam 72 is sealed by a second

tongue tape 74. The sole liner 40 is attached to the inner, upper liner 36 by a bottom seam 82 that completely encircles the bottom periphery of the bootie 100. This bottom seam 82 is sealed by a bottom seam tape 80. The seam tapes 60, 64, 68, 74 and 80 are preferably liquid impermeable.

[0019] The seams 62, 66, 70, 72 and 82 can be made by any of a wide variety of thread-type material in the form of strands or cords and include spun fibers, spun fibers encircling a core filament, bonded fibers and monofiliment-type material that may or may not be coated with a liquid impermeable coating. In addition, adhesives may be utilized as well as electro-die sealing methods. It is also understood that the location and number of the seams 62, 66, 70, 72 and 82 can vary tremendously depending on the type of shoe 10.

[0020] With the seam tapes 60, 64, 68, 74 and 80 positioned over the seams 62, 66, 70, 72 and 82, respectively, heat applied through the application of hot air and pressure through a nip roll is then applied to the top of the seam tapes 60, 64, 68, 74 and 80. The heat from the hot air is preselected to soften the adhesive in the seam tapes 60, 64, 68, 74 and 80 without detrimentally affecting any of

the desired qualities found in the bootie 100 of the shoe 10. An application of heat preferably ranges from about 150 degrees Celsius (302 degrees Fahrenheit) to about 250 degrees Celsius (482 degrees Fahrenheit) for most applications. A preferred application of pressure is from about 3 kilograms per square centimeter (42.67 pounds per square inch) gauge to about 5 kilograms per square centimeter (71.12 pounds per square inch) gauge such as that applied by a PFAFF®seam making machine. PFAFF®is a registered trademark of Pfaff Industrie Maschinen GmbH, having a place of business at Königstr. 154, 67655 Kaiserslautern, Germany. However, the applied temperature and pressure are completely dependent on the type of material used for the inner, upper liner 36, the sole liner 40, the threads used to create the seams 62, 66, 70, 72 and 82 or adhesives and the type of material utilized for the seam tapes 60, 64, 68, 74 and 80. By such a process, a solid structural weld is formed that provides at least a liquid impermeable quality in the seams 62, 66, 70, 72 and 82 to virtually the same extent as the remainder of the inner, upper liner 36 and the sole liner 40 with the seams 62, 66, 70, 72 and 82 covered and sealed.

[0021] An illustrative, but nonlimiting, example of this type of

seam tape, utilized as seam tapes 60, 64, 68, 74 and 80, includes a three (3) layer MF-12™ manufactured by Nisshinbo Industries, Inc., having a place of business at 31-11 Nihonbashi Ningyo-cho 2-chome Chuo-ku, Tokyo, Japan. A second illustrative, but nonlimiting, example of this type of seam tape, utilized as seam tapes 60, 64, 68, 74 and 80, includes Model 2000 manufactured by Melco Embroidery Systems, having a place of business at 1575 West 124th Avenue, Denver, Colorado 80234. A third illustrative, but nonlimiting, example of this type of seam tape, utilized as seam tapes 60, 64, 68, 74 and 80, includes Model ST-302 manufactured by Bemis Manufacturing Company, having an address at 1 Bemis Way PO Box 717, Shirley Massachusetts 53085-0901.

[0022] The inner, upper liner 36, either by itself or in conjunction with a plurality of additional layers of textile-type material is liquid impermeable, which provides protection from liquid for the foot. A preferred definition of liquid impermeable is that the inner, upper liner 36 does not leak as indicated by the presence of detectable liquid on the exterior of the inner, upper liner 36 when applied with water having maximum pressure of 36 milibar (0.5 p.s.i.g.) for one (1) minute. An alternative test method is for the inner,

upper liner 36, in the form of fabric only, being able to pass the hydrostatic test for textile fabrics, which is a determination of the resistance to liquid penetration established by the International Organization for Standardization under ISO-811. Another applicable, but less recognized, test method is that designated ASTM D751, by the American Society for Testing and Materials. The hydrostatic resistance of the inner, upper liner 36 in the form of fabric only, while supported, is measured in accordance with Section 41 of this Test.

[0023] Preferably, the inner, upper liner 36 is air permeable, which allows the human foot to breathe. Air permeability of the inner, upper liner 36 is defined by the test method designated ASTM D737-96, by the American Society for Testing and Materials. This is preferably measured by a Frazier Air Permeability Tester, a Textest FX 3300 Air Permeability Tester or an equivalent type of testing device. The air permeability needs to provide for air flow of at least .03 cubic centimeter per minute per square centimeter at a pressure of a 1.27 centimeter water column (0.05 cubic feet per minute per square foot at a pressure of a 0.5 inch water column) through the inner, upper liner 36. Preferably, there is airflow of at least .05 cubic centimeter

per minute per square centimeter at a pressure of a 1.27 centimeter water column (0.1 cubic feet per minute per square foot at a pressure of a 0.5 inch water column) through the inner, upper liner 36. More preferably there is air flow of at least .15 cubic centimeter per minute per square centimeter at a pressure of a 1.27 centimeter water column (0.3 cubic feet per minute per square foot at a pressure of a 0.5 inch water column) through the inner, upper liner 36 and most preferably there is air flow of at least .51 cubic centimeter per minute per square centimeter at a pressure of a 1.27 centimeter water column (1.0 cubic feet per minute per square foot at a pressure of a 0.5 inch water column) through the inner, upper liner 36. As an alternative embodiment, the inner, upper liner 36 is air impermeable, which means there is air flow of less than .03 cubic centimeter per minute per square centimeter at a pressure of a 1.27 centimeter water column (0.05 cubic feet per minute per square foot at a pressure of a 0.5 inch water column) through the inner, upper liner 36.

[0024] In addition, the inner, upper liner 36 is moisture vapor transmissive, which allows perspiration and other vapors to exit the inner, upper liner 36 while still remaining impervious to fluids such as water. Liquid vapor permeability

or the moisture vapor transmission rate of the inner, upper liner 36 is preferably defined by the test method designated JIS L 1099:1993 by the Japanese Standards Association, which provides for moisture vapor transmission of at least 500 grams per square meter (14.85 ounces per square yard) or more of water (H_2O) vapor in a twenty-four (24) hour period through the inner, upper liner 36. Preferably, at least 9,000 grams per square meter (267.20 ounces per square yard) or more of water (H_2O) vapor in a twenty-four (24) hour period passes through the inner, upper liner 36. More preferably at least 15,000 grams per square meter (445.33 ounces per square yard) or more of water (H_2O) vapor in a twenty-four (24) hour period and most preferably at least 17,000 grams per square meter (504.71 ounces per square yard) or more of water (H_2O) vapor in a twenty-four (24) hour period.

[0025] Furthermore, the inner, upper liner 36 is oleophobic. The term "oleophobic" is used to describe a material that is resistant to contamination by absorbing oils, greases or body fluids, such as perspiration and certain contaminating agents.

[0026] There are a number of materials that may be utilized for the inner, upper liner 36. The type of material that can be

utilized for the inner, upper liner 36 that is liquid impermeable, air permeable, oleophobic and moisture vapor transmissive includes a treated membrane.

[0027] There is a wide variety of ways of chemically treating a membrane to make the membrane oleophobic. A first illustrative, but nonlimiting, chemical treatment can include providing a water-based dispersion having solids of an oleophobic fluoropolymer, diluting the dispersion of the oleophobic fluoropolymer with a water-miscible liquid wetting agent, wetting surfaces which define the pores in the membrane with the diluted dispersion of the oleophobic fluoropolymer, removing the wetting agent and other fugitive materials from the membrane, and coalescing the solids in the dispersion of the oleophobic fluoropolymer on surfaces that define the pores in the membrane. This is described in U.S. Patent No. 6,228,477, issued on May 8, 2001 to BHA Technologies, Inc. and is incorporated herein by reference. This is also described in U.S. Patent No. 6,410,084, issued on June 25, 2002 to BHA Technologies, Inc. and is incorporated herein by reference. This same illustrative, but nonlimiting, example fabric is commercially available as EVENT® Fabric, which is a chemically treated expanded polytetrafluoroethylene (hereinafter also re-

ferred to as ePTFE) membrane manufactured by BHA Technologies, Inc., having a place of business at 8800 East 63rd Street, Kansas City, Missouri 64133.

[0028] A second illustrative, but nonlimiting, chemical treatment to make a membrane oleophobic can include putting a thin, continuous layer of polyurethane over the surface of the membrane, e.g., ePTFE. However, a drawback to this approach is that the polyurethane can absorb and retain moisture. A third illustrative, but nonlimiting, chemical treatment to make a membrane oleophobic can include applying a fluorinated urethane to the membrane, e.g., PTFE. This same illustrative, but nonlimiting, commercial source of fluorinated urethane is NRD-342™ that is available from E. I. du Pont de Nemours and Company, having a place of business at 1007 Market Street, Wilmington Delaware 19898. These example chemical treatments, which prevent the membrane from having an affinity for oil should not be deemed an all-inclusive listing.

[0029] The sole liner 40 is impervious to both liquid and air. A preferred definition of liquid impermeable is that the sole liner 40 does not leak as indicated by detectable liquid on the exterior of the sole liner 40 when applied with water having maximum pressure of 36 milibar (0.5 p.s.i.g.) for

one (1) minute. An alternative test method is for the sole liner 40, in the form of fabric only, being able to pass the hydrostatic test for textile fabrics, which is a determination of the resistance to liquid penetration established by the International Organization for Standardization under ISO-811. Another applicable, but less recognized, test method is that designated ASTM D751, by the American Society for Testing and Materials. The hydrostatic resistance of the sole liner 40 in the form of fabric only, while supported, is measured in accordance with Section 41 of this Test.

[0030] The absence of air permeability of the sole liner 40 is defined by the test method designated ASTM D737-96, by the American Society for Testing and Materials. This is preferably measured by a Frazier Air Permeability Tester, a Textest FX 3300 Air Permeability Tester or an equivalent type of testing device. The air permeability needs to provide for air flow of less than .03 cubic centimeter per minute per square centimeter at a pressure of a 1.27 centimeter water column (0.05 cubic feet per minute per square foot at a pressure of a 0.5 inch water column) through the sole liner 40.

[0031] In addition, the sole liner 40 is impervious to moisture va-

por transmission. Liquid vapor permeability or the moisture vapor transmission rate of the sole liner 40 is preferably defined by the test method designated JIS L 1099:1993 by the Japanese Standards Association, which provides for less than 500 grams per square meter (14.85 ounces per square yard) of water (H_2O) vapor in a twenty-four (24) hour period through the sole liner 40.

[0032] In addition, the sole liner 40 is preferably inelastic. "Inelasticity" is defined as material that when subjected to a stress-strain test will not provide 100% recovery when deflected more than 10% from the yield point.

[0033] A first category for the type of materials that can be utilized for the sole liner 40 includes inelastic, thermoplastic material, e.g., sheet goods. This can include, but is not limited to: polypropylene; polyethylene; polyester; inelastic polyurethane; nylon; and vinyl. A second category of material for the sole liner 40, includes fiber reinforced polymeric materials. This can include fibers made of: polyester; nylon; polypropylene; polyethylene; rayon; cotton; and the like, as illustrative, but nonlimiting, examples. A third category of material for the sole liner 40, includes all nonthermoplastic material. This can include as illustrative, but nonlimiting, examples: reactive

polyurethane; epoxy; styrene; butadiene; acrylic(s); and vulcanized rubber.

[0034] A first nonlimiting, but illustrative, example of this material utilized in the sole liner 40 includes BONTEX®manufactured by Bontex, Inc., having a place of One Bontex Drive, Buena Vista, Virginia 24416. A second illustrative, but nonlimiting, example of this material utilized in the sole liner 40 includes that manufactured by Foss, Inc., having a place of 380 Lafayette Road, P.O. Box 5000, Hampton, New Hampshire 03843-5000. A third illustrative, but nonlimiting, example of this material utilized in the sole liner 40 is PORELLE®, which is manufactured by Porvair P.L.C. Company, having a place of business at Estuary Road, King's Lynn, Norfolk, England PE30 2HS. A fourth illustrative, but nonlimiting, example of this material utilized in the sole liner 40 is PORON® manufactured by the Rogers Corporation, having a place of business at One Technology Drive, Rogers, Connecticut 06263. A fifth illustrative, but nonlimiting, example of this material utilized in the sole liner 40 is TEXON® manufactured by Texon U.S.A., Inc., having a place of business at 400 Research Drive, Wilmington, Massachusetts 01887 as well as having a place of business at 100 Ross Walk, Leicester,

LE4 5BX, England. A sixth illustrative, but nonlimiting, example of this material utilized in the sole liner 40 is UP-ACO™ manufactured by Worthen Industries, Inc., having a place of business at 3 East Spit Brook Road, Nashua, New Hampshire 03060. A seventh illustrative, but nonlimiting, example of this material utilized in the sole liner 40 is SOVERE™ manufactured by Sovere s.r.l., having a place of business at Via della Metallurgia, 24 37139, Verona, Italy. An eighth illustrative, but nonlimiting, example of this material utilized in the sole liner 40 is MOREL™manufactured by Industria Chemica, having a place of business at Gradisca 18, 20151 Milano, Italy. A ninth nonlimiting, but illustrative, example of this material utilized in the sole liner 40 is ALCANTARA®, manufactured by Alcantara S.p.A., having a place of business at 1 Via Mozart, 20122 Milan, Italy. A tenth illustrative, but nonlimiting, example of this material utilized in the sole liner 40 is VITA™, manufactured by 2001 Giovanni Crespi S.p.A. having a place of business at Via Pasubio, 38 20025 Legnano, Milan, Italy. An eleventh illustrative, but nonlimiting, example of this type of material utilized in the sole liner 40 is Rhenoflex® manufactured by Rhenoflex GmbH, having a place of business at P.O. Box 150480, 67029 Lud-

wigshafen am Rhein, Germany. A twelfth illustrative, but nonlimiting, example of this type of material utilized in the sole liner 40 is manufactured by Quinorgan International, having a place of business at Polígono Industrial Pla d'en coll C/Fresser, 21-23 08110, Montcada i Reixach Spain. A thirteenth illustrative, but nonlimiting, example of this type of material utilized in the sole liner 40 is manufactured by Forestali, having a place of business at Via - Kennedy, 75 20010 Marcallo con Casone MI, Italy. A fourteenth illustrative, but nonlimiting, example of this type of material utilized in the sole liner 40 is manufactured by Bartoli, having a place of business at Via Traversa di Parezzana 12/14/16 -I 55061 Carraia Lucca, Italy. A fifteenth illustrative, but nonlimiting, example of this type of material utilized in the sole liner 40 is FOOTLEVERS® manufactured by Foot Levelers, Inc., having a place of business at 518 Pocahontas Ave. N.E., Roanoke Virginia 24027-2611. A sixteenth illustrative, but nonlimiting, example of this type of material utilized in the sole liner 40 is manufactured by Polymer Dynamics, Inc., having a place of business at 2200 S. 12th Street, Allentown, Pennsylvania 18103.

[0035] The insole 30 is preferred, but optional, and typically in-

cludes a wide variety of different materials including foam such as that made of latex and polyurethane. In addition, cellulosic materials, rubbers, nowovens, and the like, can also be utilized. The insole is merely to provide tactile comfort to the foot of the person wearing the shoe 10.

[0036] Although the preferred embodiment of the present invention and the method of using the same has been described in the foregoing specification with considerable details, it is to be understood that modifications may be made to the invention which do not exceed the scope of the appended claims and modified forms of the present invention done by others skilled in the art to which the invention pertains will be considered infringements of this invention when those modified forms fall within the claimed scope of this invention.